

SEPARATOR FOR LIQUIDS COMPRISING A SEPARATING  
CARTRIDGE, PARTICULARLY FOR SEPARATING OIL FROM  
CRANKCASE GASES

CROSS REFERENCE TO RELATED APPLICATIONS

This application is a continuation of international patent application no. PCT/EP00/04144, filed May 10, 2000 designating the United States of America, the entire disclosure of which is incorporated herein by reference. Priority is claimed based on Federal Republic of Germany patent application no. DE 199 23 093.5, filed May 20, 1999.

BACKGROUND OF THE INVENTION

The invention relates to a separator for liquids, particularly for purifying crankcase gases by removing entrained oil droplets therefrom.

The invention further relates to a separating cartridge that is suitable for installation in the aforementioned liquid separator.

An oil separator using a replaceable separating cartridge is known, for example, from published German patent application no. DE 196 45 666 A1. The separating cartridge is installed in a housing in such a way that a seal is formed between a treated gas zone and an untreated gas zone, i.e., between the oil-containing air and the nearly oil-free air, so that the gas stream to be purified must flow through a separating area of the separating cartridge. The separated liquid can exit the housing through an outlet.

The separating cartridge can be replaced when the dirt contained in the gas stream has clogged the separating material of the cartridge and the pressure drop produced by the cartridge increases to an excessive

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## SUMMARY OF THE INVENTION

Thus, it is an object of the invention to provide a liquid separator which uses a simply constructed separating cartridge that is cost-effective to produce and at the same time ensures high component reliability.

It is also an object of the invention to provide a simply constructed, cost effective and highly reliable separating cartridge for use in a liquid separator.

In accordance with a first aspect of the invention, the objects are achieved by providing a liquid separator for separating liquid entrained in a gas flow, the separator comprising a housing with a cover having an inlet and an outlet for a gas to be purified and a drain for separated liquid; a mount for a separating cartridge; and a substantially cylindrical separating cartridge received on the mount; wherein the separating cartridge comprises a separating means wound around a support member with end disks on both axial end faces thereof; wherein the end disks engage the mount to form a seal and together with the support member form a sealed assembly which divides the separator into an untreated gas zone and a treated gas zone, and wherein the mount is constructed as a nipple that is gas permeable in the area between the end disks of the separating cartridge.

In another aspect of the invention, the objects are achieved by providing a substantially cylindrical separating cartridge comprising a separating means wound around a support member with end disks on both axial end faces thereof; wherein the end disks together with the support member are engagable with a mount to form a sealed assembly which divides a liquid separator into an untreated gas zone and a treated gas zone.

The liquid separator according to the invention has a housing that can be sealed in known manner by a cover. Appropriate connections are provided to permit the passage of the gas to be purified and the drainage of the separated liquid. The liquid separator uses a separating cartridge having separating means to separate the liquid and support member to ensure the shape stability of the cartridge. According to the invention, the separating cartridge is constructed in such a way that it has an end disk on at least one of its end faces, which engages or interacts with an associated mount in the housing to form a seal. The



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If the retainer for the separating cartridge is constructed in the form of a nipple, it must be gas permeable in the area between the end disks of the separating cartridge in order to allow the gas to be purified to pass through it. The nipple can also assume certain separating functions. This is possible, in particular, if the gas to be purified is guided from the inside toward the outside. The gas then first passes through the nipple, so that a preliminary separation of the fluid can occur, and then passes through the separating material of the separating cartridge.

According to one advantageous embodiment of the inventive concept, the fitting can be provided with a return flow valve for the separated liquid. While the separator is in operation, the return flow valve is closed to prevent unpurified gas from bypassing the separator. If the oil separator stops operating or if a certain amount of separated fluid has collected, then the return flow valve opens so that the separated fluid can be discharged from the nipple.

The fitting advantageously forms a single part together with the cover of the housing. To facilitate molding of the individual parts, they can be produced separately and subsequently permanently connected, particularly by welding. The advantage of the one-piece construction is that it saves a seal.

A separating cartridge in accordance with the invention is characterized in that it is suitable for installation in a liquid separator according to the invention. Alternatively, however, this separating cartridge can also be used without a housing at installation sites where a liquid must be separated from a gas phase in a closed system. This is required, for instance, in the oil system of an internal combustion engine. The crankcase gases that are produced must be guided out of the system and the oil must be removed from them as completely as possible. The liquid separator may be inserted directly into the crankcase housing. For

this purpose, a combination of cover and fitting in accordance with the invention may be used. The separating cartridge can also be integrated into an oil filter module.

These and other features of preferred embodiments of the invention, in addition to being set forth in the claims, are also disclosed in the specification and/or the drawings, and the individual features each may be implemented in embodiments of the invention either alone or in the form of subcombinations of two or more features and can be applied to other fields of use and may constitute advantageous, separately protectable constructions for which protection is also claimed.

#### BRIEF DESCRIPTION OF THE DRAWINGS

The invention will be described in further detail hereinafter by way of example with reference to illustrative preferred embodiments shown in the accompanying drawings in which:

Figure 1 is a cross section through the arrangement of the separating cartridge with two-component end disks in a separate housing; and

Figure 2 is a cross section through a separating cartridge in a crankcase.

#### DETAILED DESCRIPTION OF PREFERRED EMBODIMENTS

The liquid separator depicted in Figure 1 comprises a housing 10, into which a cover 11 is inserted, using O-rings 12. A mount 13 constructed as a nipple for a separating cartridge 14 is welded together with the cover 11.

The broken line arrows indicate the flow direction of the gases to be purified. These gases flow through an inlet 15 into the housing 10. They pass through the separating cartridge 14 and the passages 16 provided in mount 13 and thus reach the treated gas zone 17 of the liquid separator. After that, the gases exit the liquid separator through an outlet 18.

The outlet 18 is provided with a suction relief valve 19. When the liquid separator is used as an oil separator for crankcase gases of an internal combustion engine, this valve is necessary if the gases are supplied to the intake tract of the engine. If the negative pressure

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